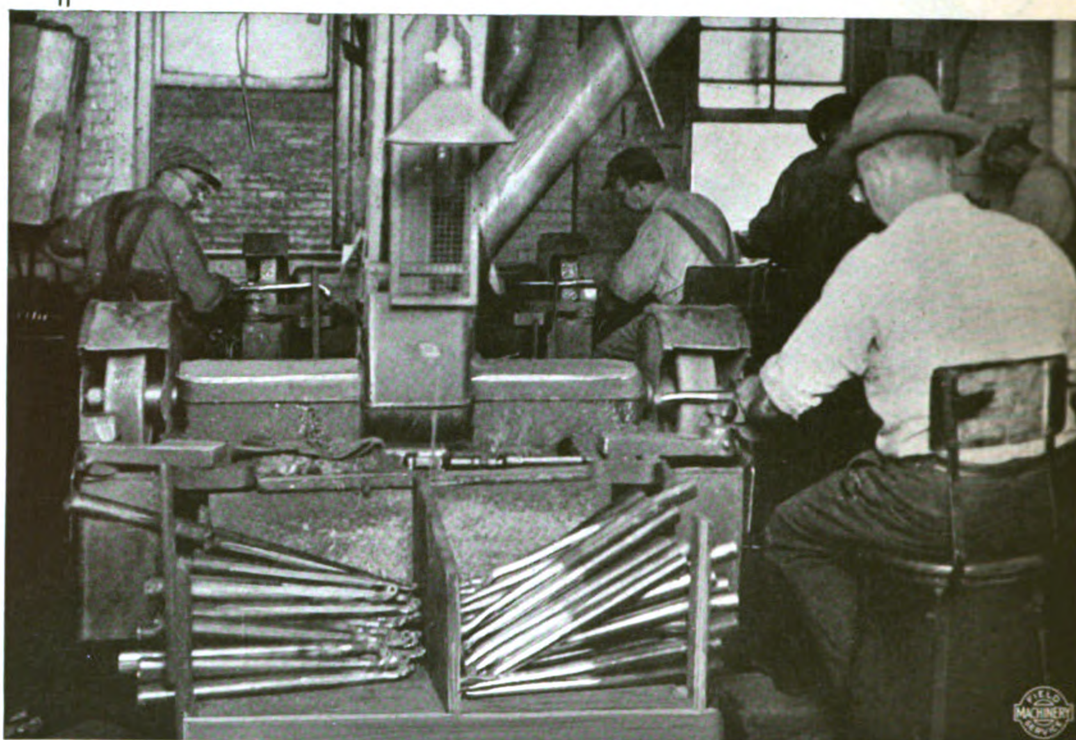
Divine Polishing Service

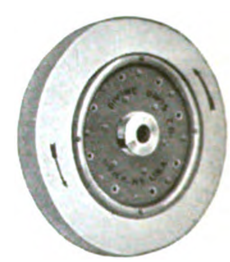


Finishing Top-Bow Sockets

The Brewer-Titchner Corporation, Binghamton, N. Y., manufactures automobile hardware. Among its products is the bow socket for one-man type automobile tops. Compare the quality of this socket with the article used a few years ago on five and six-bow tops. Brewer-Titchner has achieved a triumph in this socket. It is made in two pieces. One piece is No. 20 gage sheet steel formed to the desired cornucopia shape, and the other a steel forging. The two are welded together.

In a welding operation of this character there is considerable surplus metal and scale on the surface. This must be removed and that is just where *Divine Brothers' Polishing Service* comes in. For 5 years ten spindles in this shop have been equipped with Divine Wheels—14″, compress canvas, charged with grain 36 alundum. Production is fast and the work high-grade.

Let us tell you more about Divine Polishing Service.



DIVINE POLISHING SERVICE

Divine Polishing Service consists of:—

1—*Studies of polishing problems of all kinds.*

2—*Recommendations* based on thirty years' engineering experience.

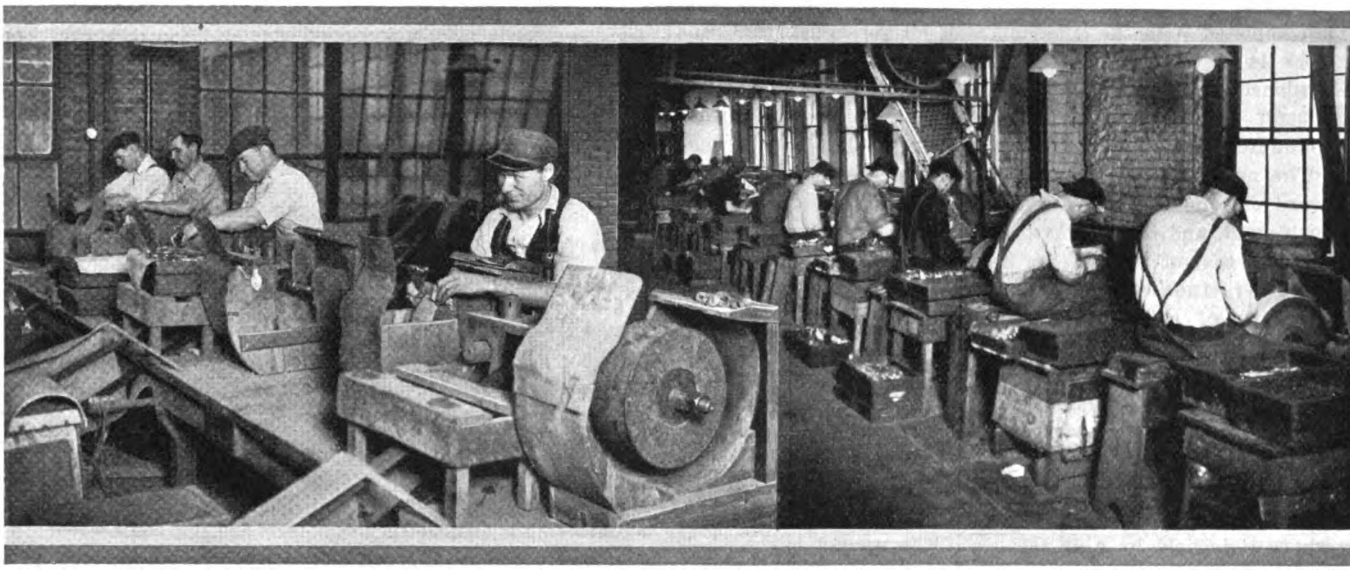
Everything For The Polishing Room

Engineering Department

DIVINE BROTHERS COMPANY, Utica, N. Y.

Metal Finishing Engineers

Principles of Metal Polishing



By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

POLISHING departments need more attention than they generally receive in manufacturing plants. To obtain the best results, the polishing equipment should be installed in a room provided with good lighting and ventilation, and should be given the same attention by the man in charge of production as are the other shop departments. Instead of this, the polishing department is frequently located in the basement or in some dark corner of the shop, where the conditions are not satisfactory for good work; and when no particular attention is given to the department by the production manager, the foreman may initiate his own policy, resulting in lack of standardization, thereby often increasing the cost and lowering the quality of the product.

There is need for standardized practice in the polishing department as well as in the machining departments; but frequently when a matter pertaining to polishing, such as the kind of wheel or abrasive to use, comes to the attention of the management, it is simply referred to the boss polisher, and his judgment prevails. Sometimes his recommendations are correct; often they are not. The boss polisher is usually a graduate from the ranks and frequently looks with suspicion on any new idea that affects his work, or on the introduction of new devices or tools that may result in a change in practice being forced upon him. At any rate, standards are not generally followed except those founded on the experience of that particular foreman. There seems to be a feeling in many organizations that polishing is a phase of manufacturing where efficiency need not be seriously regarded and where engineering has no place. In reality, there are few departments where the installation of improved methods and equipment will reflect more directly on the quality and cost of the work produced than in the polishing room.

This is the first article of a series on polishing which will cover the general principles of metal polishing, polishing wheels and abrasives, polishing methods and equipment, and the making of polishing wheels. A number of examples of polishing practice in the metal-working industry will be included. The articles will deal with the art of metal polishing in all its phases, and will call attention to details that are not always regarded as important. They will prove of especial value owing to the fact that polishing has received but little attention in the technical press in the past, and they will deal with the subject in a more complete manner than has been done hitherto.

The same care should be exercised to bring about polishing efficiency as is generally done to secure better results in other manufacturing departments such as, for example, the milling and planing departments, where improved or automatic machines are frequently coming into use and faster working equipment is being introduced. It probably is true that since the polishing department has been conducted on such a neglected basis for so long, manufacturers fail to appreciate the improvements that are possible by inaugurating a change in policy. To sum up the whole situation, the average polishing department is operated at an expense out of all proportion to other departments; polishing wheels for example, are used long after they are out of true, so their efficiency is decreased sometimes as much as 50 per cent. This would not be tolerated in a modern machine shop.

Terms Used in the Polishing Field

In general, any wheel made from whatever material—leather, canvas, or wood, for example — that has a polishing abrasive glued to its face, is a polishing wheel. In a general sense, any operation performed on a polishing wheel may be termed polishing. It embraces everything from the "flexible-grinding" operations performed on rough forgings such as axes and picks, and the removal of flash from table knives and forks, to the production of the brightest luster, such as is given to surgical instruments, high quality scissors, and other kinds of general hardware. Strictly speaking, the former class of work, which consists of grinding away metal preliminary to the luster producing process, should be known as "flexible grinding," as should all other operations in which a flexible polishing wheel removes metal preparatory to plating, painting or enameling the surface. In contradistinction to flexible grinding is the process by which the surface of

metals is refined by a number of operations until it has been reduced to a degree of smoothness that is known as a mirror finish; that is, a finish such that the light is refracted from the surface as in a mirror. But in general, in the trade, polishing is the term used to cover all this work of refining metal surfaces. Polishing, however, does not include buffing, an operation that is performed with a buffing wheel—that is, any wheel to the face of which the abrasive is loosely applied, rather than glued.

Chisels, hammers, screwdrivers, wrenches, and similar classes of work which are to be highly finished, but not plated, usually require four operations which are: roughing, dry-fining, greasing and coloring. That is, by means of four operations all the finishing work is done on polishing wheels, including the roughing which is frequently regarded as a solid grinding wheel job. Sometimes there are two steps to the greasing operation—rough and fine greasing. For some hardware, typical of which are cheaper screwdrivers and wrenches that do not demand a high finish, two operations are sufficient—roughing and dry-fining.

For knife blades and cutlery the roughing operation is performed with solid grinding wheels and the polishing is known as fine or blue glazing, but these terms are never used when referring to the polishing of hardware parts, plumbers supplies, etc. A term used in finishing German silver, white metal, and similar materials is "sand-buffing," which, in distinction to the ordinary buffing operation that is used only to produce a very high finish, actually removes considerable metal, as in rough polishing or flexible grinding. For sand-buffing, rotten-stone and pumice are loosely applied.

Although this series of articles does not deal with the buffing phase of metal finishing, something should be said regarding the art which will clearly define it and remove the possibility of its being regarded as polishing. Buffing is not so harsh an operation as polishing. The abrasives which are glued to a polishing wheel are intended to grind away roughness that the grinding wheel or other cutting tool leaves—unevennesses that are often discernible only with the aid of a microscope. Buffing, on the other hand, employs such soft cutting materials as tripoli, lime, crocus or rouge prepared in cake form with tallow and other greases as a body, this being applied to the cloth buff by hand from time to time so that the face of the buff is furnished with a coating of this composition. Some metals, like German silver and white metal, are buffed before plating. Pocket-knife blades are polished with emery and then highly finished (colored) by what is known as "crocus polishing," in which a wheel, similar to a leather-faced wood polishing wheel is used for buffing. Steel parts to be plated are usually prepared for plating by polishing, buffing being employed to give a luster to the plated surface.

The Relation of Design to Finish

The best results in polishing may often depend upon the design of the piece. In fact, the proper place to approach the polishing industry with a view to improving results is in the drafting-room, for in the designing of any new article, the manner and quality of finish can be greatly influenced by the contour of the part. It is often possible to eliminate small concave surfaces without affecting the appearance or the usefulness of the part, and by this means make it possible for a polishing wheel to reach all surfaces to produce the desired finish. The contour should, if possible, be such that it can be readily followed by the polishing wheel. Oftentimes a small expenditure in forging or in casting, by making minor changes in dies or patterns, will result in a large saving in finishing the article. It is not unusual, by some simple change in the original design, to obtain a sufficient reduction in the cost of finishing, to create a substantial advantage over a competitor.

The polishing of large surfaces is not difficult—it is the small concave surfaces, corners, and recesses that are expensive to finish, because it is almost impossible for a narrow-faced or small-diameter wheel to work effectively at the desired speed and reach such inaccessible places. The great number of these difficult surfaces found in the design of gun parts makes the finishing of this class of work comparatively expensive and the methods of performing the work of special interest. The exterior surfaces of those parts which make up the attractive appearance of firearms cannot be dispensed with without seriously affecting the market value of the product, but there are a great many articles which are finished by polishing that could easily be changed in design to facilitate the work of polishing without affecting in any way the selling value of the product. These things should receive careful consideration by the management of any manufacturing organization.

The methods of performing various operations prior to polishing also have a direct affect on the cost of finishing as well as on the quality of the finished surface. A good illustration of this phase of the industry may be noted in connection with the production of axe heads and similar forged implements. In forging, scale gathers on the surface of the hot metal and in the forging operations becomes imbedded into the surface to such an extent that in finishing, the pitted surfaces thus produced must be removed, which sometimes requires the grinding away of 1/16 inch of metal in order to reduce the axe head to a condition where it can be finished satisfactorily. To remove this unnecessary metal the practice followed in one shop was first to use a solid grinding wheel, which left a wavy surface so that it became necessary to semi-finish-grind before any polishing could be done. The result was that several operations were required to finish the axe head, whereas, with proper attention to the forging of the heads these operations could have been reduced. The method of manufacture was later changed and the work done without these extra operations. The elimination of grinding on a solid emery wheel was accomplished by simply wire-brushing the scale as it appeared on the hot forging between operations. There are many similar instances where great savings in polishing costs could be made by some such simple means as that mentioned.

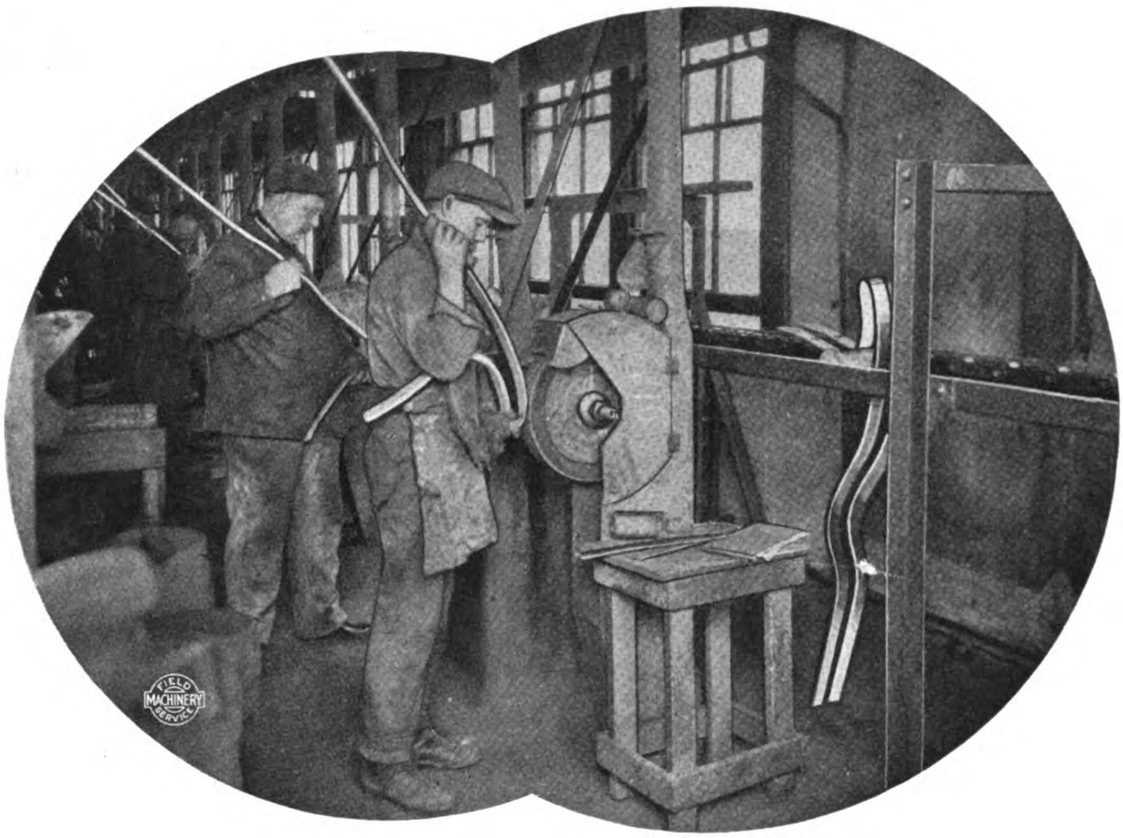
Broader Application of Polishing

The advantages which may be obtained by flexible grinding with formed-face polishing wheels have resulted, during recent years, in this means being used largely for certain classes of work to supplant the use of solid grinding wheels. This is made possible by the improvement in polishing wheel design to an extent that the coarser-grain, fast-cutting artificial abrasives commonly used for flexible grinding may be effectively held on the periphery of the wheel. In this connection, of course, the holding power of glue and the resistance to frictional heat produced are of vital importance. Work produced by polishing wheels instead of solid grinding wheels is economical, because with the solid wheel the surfaces left are wavy, so that a number of operations are required to polish the surface. The forgings and castings are often taken directly to the polishing department for roughing without being first ground, and if the polishing wheel is properly designed and applied, it will leave a smooth surface for subsequent operations. This principle of employing a flexible grinding tool rather than a solid wheel results in fewer operations being required to finish a surface.

* * *

A certain type of foreman prides himself on treating all men alike, but he might just as logically take pride in the fact that he applies the same methods to the heat-treatment of all kinds of steels. Men differ in analysis far more widely than do steels.

Divine Polishing Service



Produces Finely Finished Motor Car Bumpers

Each operator polishes 200 to 225 bumpers in a 9-hour day. Divine Polishing Service makes this possible. The picture was made through the courtesy of the Metal Stamping Company, Long Island City, N. Y.

The bumpers are of spring steel, ground, polished, plated and buffed—a fine finish, a high-grade product. Prior to receiving the nickel plate bath, each bumper is polished, grease being applied to the surface of the wheel so that a fine finish is obtained.

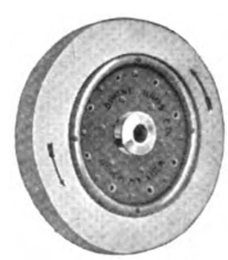
Fifty Divine compress canvas wheels 14″ diameter by 4″ face are used, set up with 180 alundum and revolving at approximately 7300 feet per minute. Sixteen wheels are in operation at a time—changed twice a day.

Let us tell you more about Divine Polishing Service

ENGINEERING DEPARTMENT

DIVINE BROTHERS CO.

UTICA, NEW YORK



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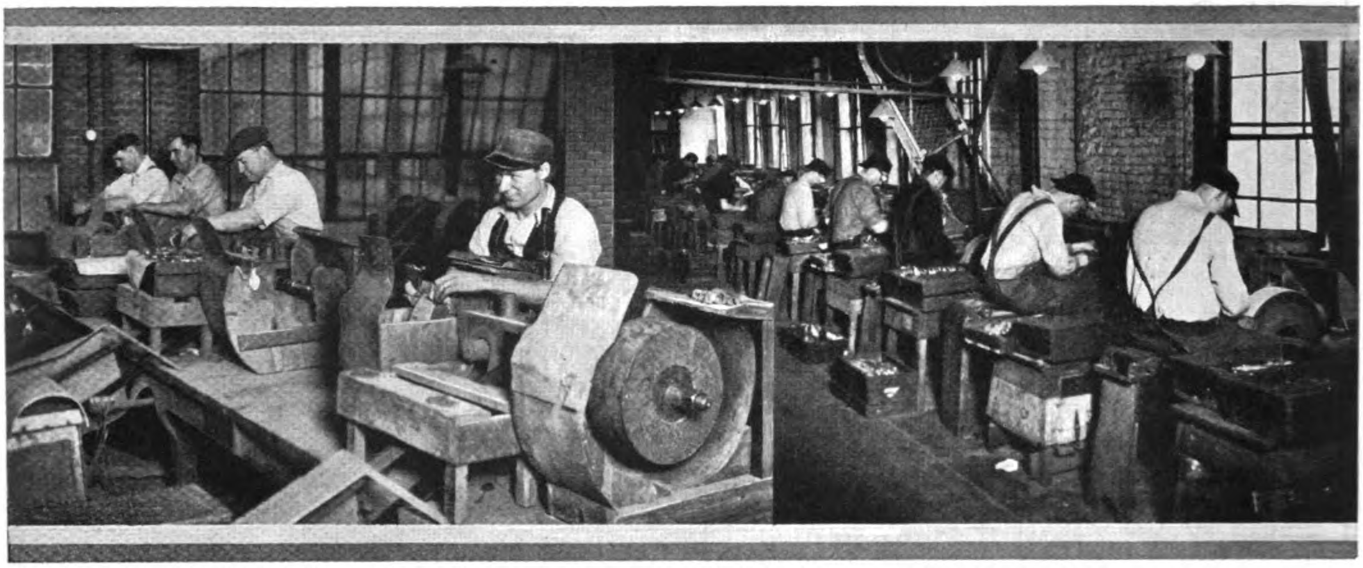
Everything For The Polishing Room

Properties of Glue for Polishing Wheels



By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

ONE of the chief factors in a metal polishing room is the quality of glue employed; another is the manner in which it is prepared and used. Glue is susceptible of rapid deterioration and loss of holding power; this fact is not as well understood by polishers as it would be if mechanical rather than chemical action only were involved.

Failure to select, prepare, and use glue properly gives unsatisfactory results no matter what kind of polishing wheel is used or what the general working conditions are. This should not be taken to mean that polishing cannot be done with an inferior grade of glue, because in polishing rooms where this most vital element has not been duly considered glue of inferior quality is often used. But since glue is the tying element between the wheel and the abrasive it stands to reason that the real success of the operation depends on the glue and the method of using it.

Kinds of Glue Used in Polishing Rooms

There are three kinds of glue, namely, bone, hide stock, and fish glue. Hide stock glue is most generally used in the polishing industry. It is made from the skins of cattle, rabbits, and other animals. The stock is first limed to remove the hair, which causes it to swell and insures rapid extraction of the glue; liming also frees the hide of material which would impair the quality of the glue. The lime that is often in water in which glue is soaked preparatory to using, in addition to that already contained in the glue from the preparation process, reduces its value as a bonding agent.

Glues are often blended; for example, a sheep stock and goat stock glue make an exceptionally strong holding medium, and, when mixed with ox fleshings, form a glue which has more strength than a glue made entirely from rabbit or some other similar stock. The cheaper grades of glue are usually mixtures of bone and hide glues.

The color of glue, which is usually dark and hazy, may be lightened by the use of oxide of zinc, chalk, or talc, and these will produce a white or opaque fluid. Sometimes the use of these and similar substances in glue is an advantage in the polishing room, if the moisture or humidity is high, as when the factory is near a body of water. Under these conditions glue containing the substances mentioned will set easier and retain its strength longer. The use of such combinations for polishing wheels, however, should only be undertaken under the direction of those understanding the conditions.

Fish glues are not suitable for use in metal polishing, in spite of the fact that the most powerful adhesive known (isinglass) is a fish glue. Isinglass is marketed in various solid forms, and is sometimes mixed with hide stock glue to make belting cement and to bond bullneck polishing wheels in which disks of this kind of leather are glued together to construct a wheel. It is not used, however, to hold the abrasive to the face of polishing wheels.

Properties of a Good Glue for Polishing Wheels

The qualities which glue should possess in order to be valuable in the polishing industry are jelly strength, viscosity, and flexibility. Flexibility is the most important of these three qualities, because 95 per cent of all polishing wheels are flexible, or should be, on the surface. If the glue is brittle, it will break from the wheel. Jelly strength is determined by placing glue jelly at a certain temperature in a glass and allowing a wire weighted at the upper end to pass down through the jelly a predetermined distance in a certain time. The weight that is required to meet the predetermined conditions of distance and time is a measure of the jelly strength. Viscosity is determined by the time required for glue to flow over a given area, as compared with the time that water will flow over the same area. For example, the best grades of glue may require forty-five seconds to flow over an area that water will flow over in fifteen seconds. The viscosity is a measure of the adhesive power of glue.

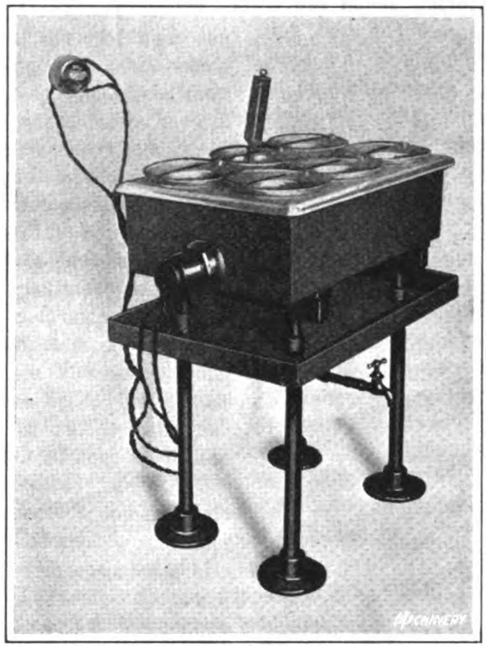
Importance of High-quality Glue for Polishing Wheels

The importance of using a good quality glue to hold the abrasive grains on polishing wheels cannot be emphasized too much. The heat generated in polishing has a tendency to melt the glue, and as a result the emery is lost from the wheel face. This point is of special importance in automatic or semi-automatic polishing machines, although designers of these machines have not always paid sufficient attention to it. Some provision should be made in such machines to keep the wheels cool so that the glue will remain hard and retain its holding power.

In combination with the crushing point of the abrasive, the melting point of the glue controls the permissible wheel speeds, so that with the use of a high quality glue, wheel speeds may be greatly increased. It is because of the fact that no standards have been adopted for using or making glues of a definite holding ability, that standards have not been established for the working speeds of polishing wheels.

Glue cools in two or three hours, but it does not set, so that wheels should not be used within forty-eight hours after gluing. If artificial means are employed to hasten the hardening of the newly set up wheel-head, the glue draws away from the abrasive grains, forming a pocket in which the abrasive soon becomes loose, instead of firmly holding the grain in bond as it should and will, if permitted to set in a mild atmospheric temperature. Artificial heat used to hasten the setting of glue on polishing wheels soon causes the glue to become useless as a dependable bonding material.

The character of the work to be polished should be considered in selecting the glue, as well as the grain and kind of abrasive and the size and speed of the wheel. For the coarser abrasives a heavy glue is required, while for the finer grains (above No. 80) a thin glue made by diluting the heavy glue works to better advantage. When surfaces are to be polished by using first a coarse abrasive below No. 46 and later a finer grain, say No. 120, the wheels should be set up with glues of proper consistency taken from separate pots, because putting the fine grains into the heavy viscous glue that is necessary for the coarser numbers will not produce a good working surface on the wheel. It is difficult to embed the fine emery properly in heavy glue; the abrasive tends to rest on the surface instead of penetrating it, thus giving the face of the wheel a packed appearance. For the best polishing, high-grade hide stock glue should always be used. There are now on the market a number of specially blended glues for setting up polishing wheels—glues that will hold the abrasive satisfactorily under normal working conditions.



Satisfactory Type of Glue-heater

Preparation and Use of Glue

Commercial glue is furnished in a cake form, in flakes, or pulverized; it should be kept in a dry place so that it will not mold. No matter what the form of the glue is, it should be soaked in cold water for several hours before it is heated. The water used for this purpose ought to be distilled; the drip from steam radiators may be utilized, if desired. The use of distilled water guards against chemical action due to impurities in the water, which may contain sulphur, lime, or iron, all of which are injurious to glue. If glue is soaked in hot water, it quickly decomposes and its strength is impaired. The amount of water that should be used varies with different makes and qualities of glue and should be stated by the maker of the glue.

Glue cake, ¼ to ½ inch thick, requires about twelve hours to dissolve; it should be broken into small pieces before being put to soak. Flake glue requires from six to eight hours, according to the thickness of the flake. Pulverized glue may be dissolved in from three to three and a half hours. The soaking process should not be hurried.

Glue should not be heated until it has been absolutely dissolved by soaking in cold water. After being heated, the glue may be diluted with hot water to obtain the required consistency. Glue should never be heated sufficiently to make it boil. It is also bad practice to prepare large quantities of glue at a time, because it loses its strength rapidly after being under heat for about four hours.

Satisfactory Type of Glue-heater

A satisfactory glue-heater should have ample accommodations for all the glue that will be prepared at one time, say, six or more glue kettles, as shown in the illustration. The kettles in which the glue is heated should be made of aluminum, and their size and number should provide for handling glue of various consistencies in sufficient quantities to last not more than four hours. Aluminum is the most suitable metal for glue pots because the scum on the glue does not adhere to the inside of the pots, so that they are easily cleaned.

A thermometer should be part of the equipment of a glue-heater, for the temperature at the bottom of a pot 6 inches deep should not be over 150 degrees F., which will bring the temperature at the top to about 140 degrees F. Higher temperatures than this destroy the adhesive power of glue. The pots should be thoroughly cleaned at least once each day. The glue that has become cooled should never be reheated, as reheated glue loses about fifty per cent of its strength. It is good practice to have a new lot of glue ready for use before the glue already prepared is consumed.

The heater shown has recently been placed on the market, and is intended to meet the requirements that have been established by research work on glue in polishing work. This heater is provided with a thermostat for the regulation of heat. A wheel-stand is also a necessary piece of the equipment; this stand should be so placed that there is but a small space between the glue pots and the wheel that is to be set up. Both the heater and the wheel-stand are adjustable for height.

Proportions of Glue and Water

The glue should be diluted more and more as the abrasive grain decreases in size. For instance, suppose that the glue has been melted in the glue-heater in the proportion of two pounds of water to one pound of dry glue, and that this is suitable for a coarse grain; then for finer abrasive grains, hot water can be added to give the right consistency. It is possible to perform practically all the operations included under the head of flexible grinding and polishing by using a glue of the jelly strength, viscosity, and flexibility necessary for the coarser abrasives and thinning it for the finer abrasives. Properly diluting this quality glue by the addition of water does not cause the heavy glue to lose its strength sufficiently to prevent it from holding the finer abrasives used in the finishing operations.

* * *

The Bureau of Standards has made some interesting investigations on reclaiming lubricating oils. The experiments show that with a commercial type of oil reclaimer oil can be reclaimed so it will be similar to new oil except as regards sediment. Further investigations are necessary to develop means for removing this sediment, which is probably carbon.

General Construction of Polishing Wheels Used for Metal Finishing—Characteristics of Polishing Abrasives

By BRADFORD H. DIVINE, President, Divine Bros., Utica, N. Y., and President ot the Metal Finishers' Equipment Association

THE principal materials from which polishing wheels are made are wood, leather, canvas, cotton cloth, felt, paper, walrus or sea-horse hide, sheep-skin, impregnated rubber and canvas composition, and wool. The leather-covered wood wheel is very popular with polishers, although its disadvantages are numerous. It frequently gets out of balance and the leather facing, if not treated with great care, becomes loose and dangerous to the operator. It is the most common form of polishing wheel, due principally to its being cheap and easy to make.

Leather-covered Wood Wheels

A leather-covered wood wheel that will retain its balance and shape should be made from a wood that is not likely to change shape easily due to climatic conditions. Poplar and basswood are not suitable, although they have been used to some extent, because they are generally easily influenced by changes in temperature and humidity, resulting in warpage, shrinkage, and general distortion. They are very porous, so that they readily absorb moisture. Polishing wheels are operated in hot factory rooms where artificial heat is supplied in winter, and where they come in contact with moisture when the glue and abrasive are being soaked off in water. Hence, they are subjected to every influence that would cause them to change shape.

The best woods from the standpoint of stability under such conditions are black walnut, mahogany, and cherry; but their use for polishing wheels is commercially impracticable on account of their cost. The most suitable wood for general use is air-dried or kiln-dried white pine. It does not change its shape readily through atmospheric conditions and gives general all-around satisfaction.

The old style of leather-covered wood wheel consisted of a solid or laminated wood block with the leather facing strap glued in place. The modern construction is as follows: The wood wheel is made up in layers of ½-inch stock with the grain of alternate layers at right angles. The layers are glued together and held under pressure while both the wood and glue are hot. This construction lessens the likelihood of the wheel's changing shape due to the influence of heat or moisture. The wheel may be covered with a good quality of oak-tanned back strip leather, or bullneck; or if desired, felt may be used. These materials are pegged and cemented securely to the wood.

Leather and canvas are the materials most commonly used in polishing wheel construction. Bullneck leather wheels are made of oak-tanned bullneck leather cut into disks of uniform thickness and cemented together. The thickness of bullneck leather varies; the thin pieces of leather produce a wheel of hard density for use on one class of work, while the thicker bullneck leather, which may be from ½ to ¾ inch in thickness, produces softer wheels used for a different class of work. "Extra hard" leather wheels are made from split leather.

Canvas wheels are made in a variety of ways; in some the disks are cemented together, while in others they are hand-sewed or "quilted." Wheels that are cemented are very hard and used for rough coarse work, while those that are sewed may be made of varying densities by sewing together a larger or smaller number of disks into sections and gluing them. A more flexible canvas wheel is the hand-sewed form, made by sewing all the disks together to obtain the required face width. The sewed wheels are a very old style, and are used for carrying the coarser abrasives when performing rough polishing operations. The main objection to the use of wheels of this kind is that the twine with which they are sewed sometimes breaks under the hard pressures to which wheels of this kind are subjected. Copper wire is used in place of twine where the wheel is to be used under severe conditions. The layers of canvas in wheels other than the "solid cemented" or hand-sewed may be glued from the center outward for varying distances, depending upon how much spread is desired for the face of the wheel. Wheels in which the disks are held together by sewing and which are not stiffened by the use of glue, usually require metal side plates to support the canvas disks.

Muslin, Felt, Paper, Walrus Hide and Sheep-skin Wheels

Muslin wheels are made from sewed buffs glued together, the outer edges of the wheel often being left open or free from glue to give an open face to any desired depth. The sides of these wheels are supported by canvas disks. A polishing wheel of this type is softer than a hand-sewed canvas wheel.

Wool felt wheels are made from sheets of woven felt, ¼ inch thick, cemented together; this makes a flexible resilient wheel, the density of which may be varied by sewing two or more disks together and then cementing these to form

a wheel. Solid wheels made of Spanish or Mexican felt are quite popular for fine finishing work, but have little value as general utility wheels.

Paper wheels are made from strawboard paper disks and are cemented together under pressure to form a very hard wheel for rough work. Softer wheels are similarly made from felt paper. For those who are partial to the use of leather-covered wheels, a leather face may be cemented to these paper wheels as a substitute for leather-covered wood wheels. They will run true and retain their balance and shape, if properly used, for a long time.

Walrus leather, or sea-horse hide, is a suitable material for polishing wheels because of its thickness and its tough open fibers, which make it desirable for fine finishing wheels. Its thickness makes it possible for wheels up to 1½ inches face to be made up without seams. One general criticism of polishing wheels made from leather disks of any kind is that the grain side is usually harder than the flesh side, so that a wheel constructed of cemented leather presents a face that is uneven in hardness and that wears in ridges. This reduces the efficiency of the wheel and requires frequent truing up. As a result the life of the wheel is greatly reduced.

Sheep-skin polishing wheels may be made by cementing disks together, or by a loose construction in which the disks are sewed around the arbor hole only; or they may be hand-sewed. The cemented sheep-skin wheels are soft and pliable, and are used for fine finishing. The loose-disk sheep-skin wheels are suitable for even finer work and for buffing soft metals. The hand-sewed wheel is pliable and is used extensively in the jewelry trade; it is also suitable for buffing by the application of tripoli or other buffing compositions.

Vulcanite wheels, which are made from rubber and impregnated with abrasive, are sometimes used for polishing the flutes of reamers and the spiral grooves of drills and augers.

Materials for Buffs

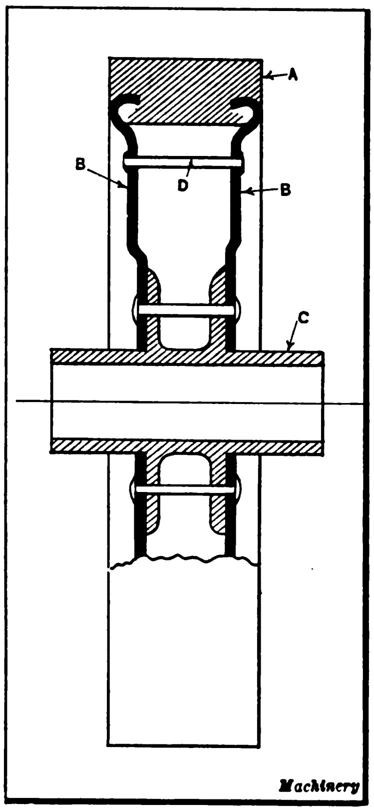
As already mentioned, muslin polishing wheels are made from sewed buffs. In addition to their use for "cutting down" soft metals, buffs are regularly used for coloring various metals. They are made from all kinds of weaves and weights of cloth, and therefore vary greatly in their cutting or burnishing ability. There are two main classes of buffs, designated according to the method by which they are made—the "pieced-sewed" buffs, which are made from various weaves and weights of cloth, and the "full-disk" buffs, which are made from the best sheeting and shirting.

Bleached or unbleached cloth may be used according to the kind of surface for which the buff is intended. Bleached cloth is harder and stiffer than unbleached cloth, and is used for the faster cutting buffs the buff sections being made in plies of from eighteen to twenty thicknesses each. Coarsely woven unbleached cloth is recommended for highly colored work on soft metals, while the finer woven unbleached cloths are better adapted for the harder metals. The cloth used in buffs made for reliable service varies from 64 by 68 threads per square inch, to 92 by 96 threads. The material governs the ability of the buff to stand up in use, because the crocus, tripoli, rouge, and other cutting or coloring compositions should—for proper buffing—adhere to the ends of the threads instead of to the side of the cloth. Buffs may be sewed in any manner desired, but are usually sewed in spirals with the stitching ¼ or ⅜ inch apart.

A stiff buff, when working at the usual speed, is not suitable for "cutting down" soft metal or for use on light plated ware, but is used on the harder metals and for heavy nickel-plated articles. In the smaller sizes, a stiff buff may also be suitable for German silver, nickel, and white metal before it is plated. For buffing precious metals, wheels made of Canton flannel and wool are invariably used.

"Compress" Polishing Wheels

Many attempts have been made to produce a polishing wheel that could be made to suit various requirements of finish and that would not be affected by atmospheric changes. It is apparent that a wheel that runs true and that does not vibrate at high rotative speeds is desirable, and that such a wheel would do better polishing and increase production. The "compress" type of polishing wheel with the material placed crosswise of the face of the wheel, instead of disk-wise, was designed with the idea of producing a wheel that would be suitable for all classes of work when made of the proper materials.



Cross-sectional View of Compress Polishing Wheel

The compress wheel, a sectional view of which is shown herewith, is made of rectangular pieces of leather, canvas, felt, paper, or other material, arranged radially and compressed to form a ring or cushion *A* of polishing material of one or more inches in depth. This cushion of polishing material may be varied in density to suit the requirements. The cushion is assembled with two side plates *B* which engage annular recesses in the material and which are riveted to a cast-iron hub *C*, thus tying the whole together in a flexible wheel. This construction permits the cushion to be shaped to conform to the curvature or contour of the piece to be polished and makes it possible to maintain this shape.

The wheels are turned on a lathe, so that when put in use they can be accurately balanced; with proper care they will mantain this balance. The side plates *B* carry several brass tubes *D* riveted to them as shown. These tubes receive pieces of lead wire for balancing the wheel after "setting-up" with abrasive and glue. The material in the cushion, being placed on edge, permits the glue to set well and to hold the abrasive securely. The glue has an opportunity to penetrate into the material, whereas on a strap-covered wood wheel, for example, the glue cannot penetrate, but rather lies on the surface, so that no great resistance to the strain produced in polishing is offered.

The difficulty encountered with a leather-covered wheel when the leather becomes loose, due to the use of water and rollers in removing old abrasive, is not met with in the compress wheel. The trouble often experienced with solid wheels made out of disks cemented or sewed together, when the disks separate at the face and cause the glue to crack and break off, cannot be encountered with a wheel of the compress type. These wheels are made in sizes of from 2½ to 24 inches in diameter and in practically any width of face. A detailed description of the manufacture of compress and other types of polishing wheels will be given in a subsequent article.

Abrasive Materials

The abrasives used in polishing and flexible grinding operations may be broadly classified as natural and artificial. The natural abrasive is corundum. This mineral in the granular form is known as emery, but this is not pure corundum, as it contains certain impurities. These impurities render emery more suitable for fine finishing operations

than any artificial abrasive. The value of emery as an abrasive depends upon the percentage of alumina, or crystalline aluminum oxide, that it contains, as this is the only element in emery that is hard enough to cut metals effectively. The impurities that are present in emery are amorphous alumina, silica, iron oxide, and other metallic oxides.

Emery is known by the locality from which it is obtained. The percentages of the alumina contained in different kinds of emery used for polishing are: Naxos emery, 63 per cent; Turkish emery, 57 per cent; and Chester emery, 55 per cent. The natural mineral corundum may be crystallized in the electric furnace to produce an artificial abrasive of the same name, although, as generally known, corundum and emery are natural abrasives and are substantially the same mineral.

The artificial abrasives fall into two general classes—those composed of aluminum oxide in the crystalline form and those composed of silicon carbide. The aluminum oxide artificial abrasives are used for flexible grinding and polishing work, but the silicon carbide abrasives are used almost entirely in the form of solid grinding wheels. A special grade of artificial abrasive alundum, which is known as the TJ grade, has, according to the experience of Divine Bros. Co., given the best general satisfaction for all flexible grinding work with compress wheels. This grade of alundum is chemically treated in its manufacture so that the grains may be successfully held by glue.

For the finer finishing and coloring work, artificial abrasives are rarely used, and for this work natural emery finds general favor. One objection to the use of coarse numbers of artificial abrasives for polishing wheels has been the difficulty of holding the grains of the abrasives to the face of the wheels; but with care in the preparation of the wheels, and, particularly, in the correct use and treatment of a proper glue, artificial abrasives can be bonded to the polishing wheel securely enough to grind and polish the hardest metals. This phase of the polishing industry, relating to the preparation of the wheels for use, will be dealt with in a following article of this series.

Although it is sometimes claimed that artificial abrasives in the finer numbers are suitable for coloring purposes on such parts as surgical instruments, high-grade scissors, and hardware, the greater part of this work is done with natural emery. For fine finishing and coloring with artificial abrasives, or in fact, with any abrasive, it is well to remember that a higher degree of luster can be produced by using a slow speed and a more moderate cutting abrasive.

Other Materials Used in Polishing and Buffing

Pumice and rotten-stone may be regarded as abrasives, but their use is limited in the metal-finishing industries. Pumice is a hardened vulcanic product and rotten-stone is a substance obtained from limestone. Both these gritty materials are used for "cutting down" metals (such as white metal and German silver) that are subsequently to be plated. They are not bonded to the wheel but are applied to it by hand during the operation.

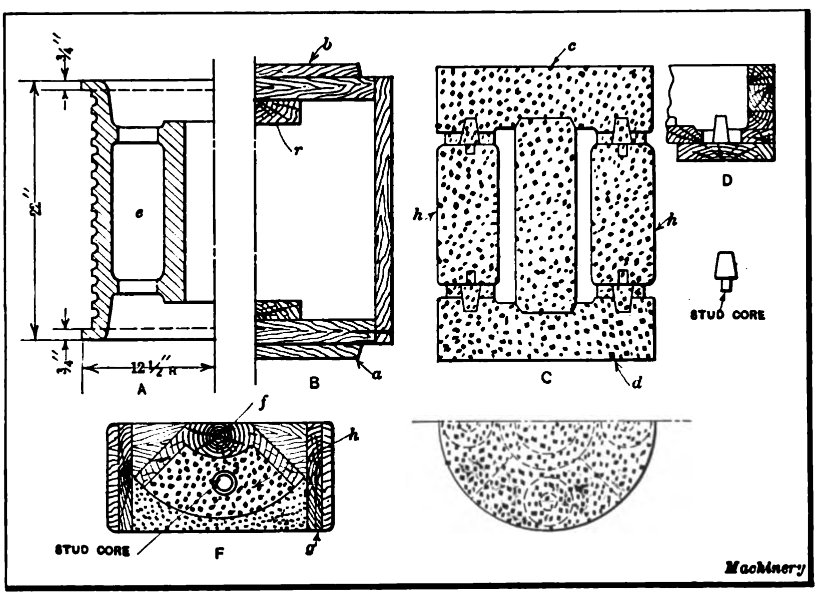
Tripoli is another abrasive used in finishing the surfaces of metal. It is easily pulverized, and is extensively used as a buffing material for "cutting down" soft metals that are to be plated. For coloring work with buffs, such materials as crocus, rouge, and Vienna lime are used. These are prepared in cake form with tallow, stearin, or petrolatum as a body. This composition adheres readily to the ends of the fabric used in the buffs. Crocus and rouge are metallic oxides and the lime is obtained by calcining limestone and certain kinds of shells.

* * *

MAKING PATTERNS FOR A WINDING DRUM BY HAND

By M. E. DUGGAN

Patterns that would ordinarily be turned up on a lathe are sometimes required to be made with hand tools. For example, the patterns for a winding drum such as shown in the half sectional view at *A*, were needed at a time when all the turning lathes were employed on important work. The patternmaker was therefore obliged to resort to the use of ordinary hand woodworking tools. The methods employed in constructing the pattern were rather unusual, although practical, and may be of interest to patternmakers handling similar work. The pattern was designed for molding on end, as this method gave a firm support for the necessarily heavy core. The result was a sound and true casting. Practically all the molding was done in the "drag flask," the cope being nothing more than a "flat back" except for the cope print impression.

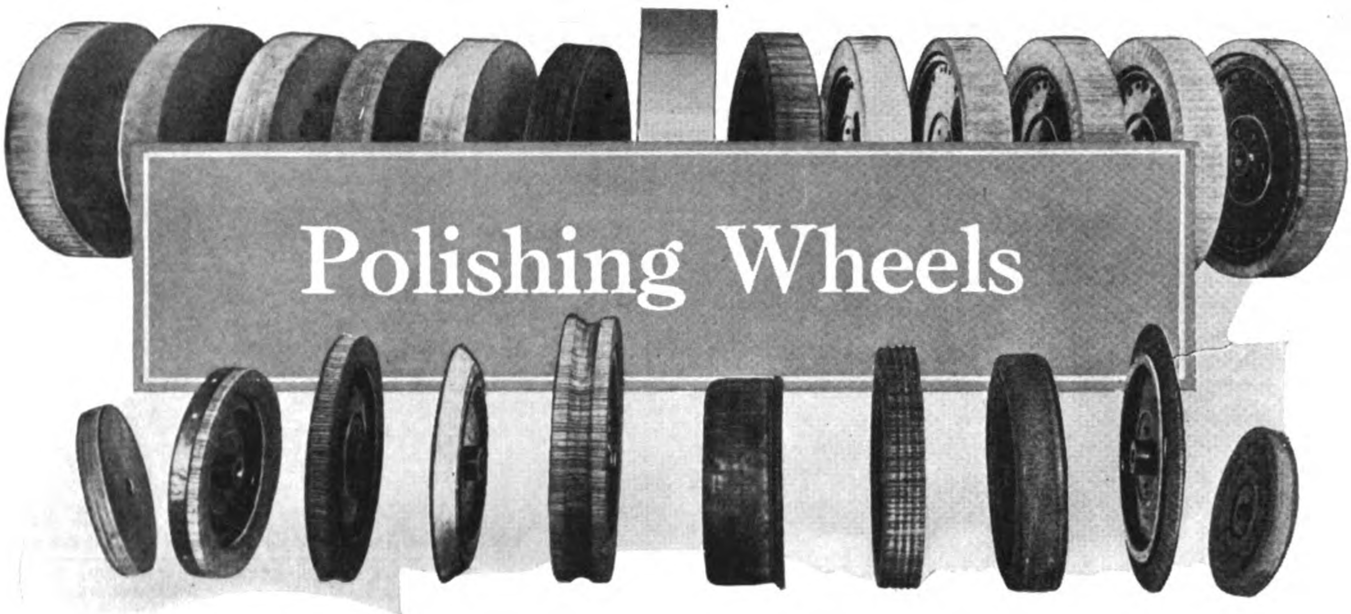


Winding Drum Pattern and Cores made with Hand Woodworking Tools

The pattern for the drum is shown in the half sectional view at *B*. As but one casting was needed the drum was made with straight sides. This left considerable stock on the winding face of the casting which had to be removed in the machining operation, but the time thus saved in making the pattern and in molding more than compensated for the extra machine work. The pattern was constructed with top and bottom heads reinforced with cross-ribs, one of which is shown at *r* in the view at *B*. The cylindrical part of the pattern was made up of 1-inch square strips. The drag print indicated at *a* was securely fastened to the bottom head of the pattern, while the cope print *b* was pinned loosely to the top.

At *D* is shown a broken section of the core-box used to form the upper section *c* and the lower section *d* of the core shown in view *C*. The core that formed the "ring chamber" *e*, view *A*, was made in four sections. The core of one of these sections with its stud core in place is shown in the view at *F*. The core-box *f* and the black sand box *g* are shown in an inverted position with one of the four core sections *h* resting on the black sand bed. The core-box and the black sand box are lifted off before placing the core in the baking oven. The sectional view at *C* shows how the completed core was assembled in the mold.

The construction of this pattern is of particular interest in view of the fact that all the work was done with hand woodworking tools and a bandsaw.



Polishing Wheels

The Manufacture of Full Disk Canvas Wheels, Compressed Muslin Wheels, Leather Wheels, Leather-covered Wood Wheels, and Walrus Hide Wheels—Second Article in a Series

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE solid canvas polishing wheel is made from one-piece or full disks of canvas known as "Dryer canvas." This is a thick heavy canvas with very coarse yarns, and is better suited to a disk form of polishing wheel than a finer, thinner canvas would be. The wheel is constructed by assembling these canvas disks into a wheel, either by gluing each disk to the nearest one to it until the entire thickness is glued together, or by sewing together a number of the disks into sections, something like buffing wheels, and then gluing these sections together. It is evident, of course, that the less glue there is in a wheel the softer it will be, and the different degrees of softness are obtained by varying the number of canvas disks put into each section before the sections are glued together. The softest possible form of canvas wheel is obtained by using no glue whatever, and sewing the layers of canvas together in several rows with heavy twine; for very hard work, such as is met with in the agricultural trade, the sewing is done with copper wire.

To stiffen the center of these wheels so that they will stand up on heavy work, it is customary to use iron or steel plates on each side, the diameter of the plates being usually about four inches less than the diameter of the wheel, leaving two inches of canvas projecting beyond the plates, free and loose to crush out and provide flexibility. When the disks are put together without sewing, that is entirely glued together, an eighteen-inch wheel, for example, is glued for a diameter of eight or ten inches at the center. The construction can, of course be varied to meet individual requirements, the whole construction depending upon the form of wheel desired for any particular class of work.

Another form of canvas wheel is made from what is known as two-, three-, four-, or five-ply canvas belting. The canvas is woven to about 1/2 inch in thickness by a process quite different from that by which the Dryer canvas is made. Wheels made of this canvas belting are much softer and more pliable than Dryer canvas wheels, but are used to a much less extent now than formerly, because a much more efficient polishing wheel can be made in the "compress" construction the manufacture of which will be described in a following article. This construction gives the softness desired in a much better form of wheel.

The compressed muslin wheel, which was formerly commonly referred to as a "rag wheel," is made by gluing together sections of pieced-sewed buffing wheels. The sections of buffing wheels are assembled into polishing wheels by practically the same methods as are used in the manufacture of the Dryer canvas polishing wheels.

Leather Wheels

Leather wheels are usually made from bullneck leather in disk form; a special quality is known as "split leather wheels," and these wheels are made from leather from which both the grain side and the flesh side have been split off, leaving the leather about 1/8 inch thick; this part is the toughest, hardest, and most uniform in grain that can be secured from a cattle hide.

The first step in manufacturing a good bullneck leather wheel is to select a hide of the proper character—one that is not filled with clay or glucose, but is left pure and porous so that it will be resilient. The hide must also be thoroughly tanned by the old-fashioned process which takes months, instead of by some of the newer processes in which the tanning is rushed; these processes do not leave the fiber of the hide in as good condition for polishing as the old-time process. The shoulder of the bull produces a hide much coarser and more sponge-like than is the same hide back of the bull's shoulder to his tail. The bull shoulder hides vary in thickness from 1/4 inch at the flank or leg to 3/4 inch, or sometimes 1 inch, at the heaviest part in the back of the neck behind the horns. In cutting the disks for bullneck wheels, the purpose for which the wheel is to be used determines what part of the hide these disks shall be cut from, in order to secure a disk as equal in porosity and density as possible.

After the disks are cut, the loose portion on the flesh side or inside is removed, and often a considerable part of the hair- or grain-side has to be removed also, on account of the deep wrinkles in the hides. These disks are then held together by glue to which has been added isinglass or some other adhesive having a toughness and strength many times greater than that of the best glue. Wheels put together with glue not mixed with isinglass will frequently split apart. Great care must be taken to see that the glue, or cement as it becomes when mixed with isinglass, is properly applied to the leather disks. Upon the application of the glue to the disk it must be immediately placed in relation to the next disk, the whole mass being kept hot; and when

the entire mass of disks for each wheel is assembled it must go into a press immediately, so that the glue will set uniformly throughout the entire wheel while under pressure. After the wheel is thoroughly dry, the center hole is bored. It is then placed on an arbor and the sides and face are trued up to the right dimensions. Bullneck wheels are commonly sold by weight, rather than by wheel units. The variation in weight of the hides, which is not controllable, prevents the manufacturer from putting out a fairly balanced wheel, and the balancing has to be done by the operator after he has set up the wheel with emery and glue.

The bullneck wheel is not adapted to finishing work on account of the alternating layers of leather and glue in the wheel. The glue is stiffer than the leather and will resist the pressure, while the leather will crush down with the result that the face of the wheel wears in ridges or grooves and cannot be kept flat. Such wheels are generally used on rough forms of work where a flat face is not essential.

Wheels made of split leather retain their shape better than regular bullneck leather wheels and are advantageous for certain classes of work. The method of construction is practically identical to that used for the bullneck wheel, the difference being only in the thickness and character of the stock used.

Leather-covered Wood Wheels

Although leather-covered wood wheels are not generally regarded as efficient polishing means, they are extensively used where the advantages of other wheels are unknown, there being a reluctancy on the part of some polishers to give up the old form of leather-covered wood wheel to which they are accustomed. The polisher knows that the leather strip on the face of the wheel often becomes loose, especially where the old heads of emery and glue are removed by a wet process. He also knows that the joining of the ends of the leather strap makes a spot which is harder than the rest of the face of the wheel; on accurate work, the shock of this hard spot can be plainly felt in the operation of the wheel, and on this account a smooth steady cut is difficult to secure.

The wood body of the wheel, especially when made of a soft wood, is susceptible to change in shape on account of dryness or moisture, and a wood wheel which runs true is a rarity and is highly prized by its owner. But inasmuch as wood wheels were one of the original forms of polishing wheels, and many old-time polishers have used them for years, there seems to be a strong conservative force that is responsible for their continued use.

The best wood from which wood wheels could be manufactured is mahogany, black walnut or other woods that are not very susceptible to the action of moisture and dryness. The cost of such woods, however, is prohibitive. Good white pine is the best common wood obtainable for polishing wheels. Bass wood and poplar are commonly used in a cheaper form of wheel, mainly because the wood is free from knots, comes in wide planks, and is easy to cut wheels from without much waste.

Fig. 1. Assembling Disks of Cloth for Solid Canvas Polishing Wheels

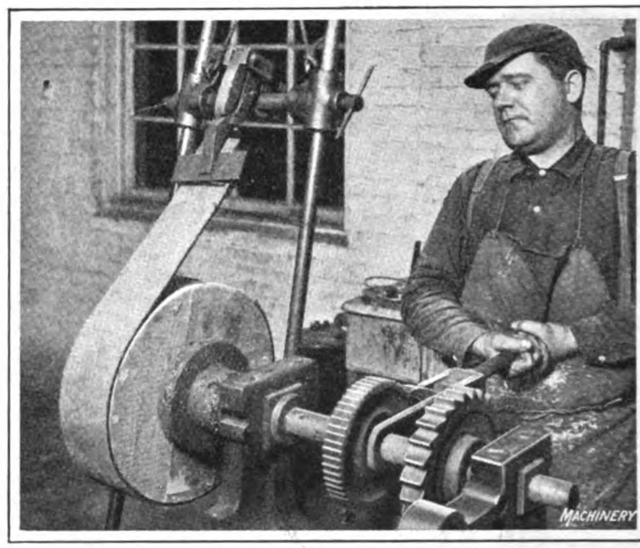


Fig. 2. Attaching the Leather to a Leather-covered Wood Polishing Wheel

In the standard pine wheel, the wood is air-dried and kiln-dried and usually cut ½ inch thick. The boards are cut in square blocks of the proper thickness for the wheel, the layers or strips being at right angles to each other and held together by means of nails (afterward removed) so that they cannot slip out of position while they are being dried in a press after the glue has been applied. After the square blocks are glued together, the center hole for the hub and the countersink for the flange of the hub are bored with a compound tool. The square block is sawed to an approximately round shape and then the wheel is turned to shape in a lathe, after the hub has been inserted.

The leather used for the covering of wood wheels is usually a strip down the back of the animal which is the closest grained, toughest and most uniform part of the hide. This is the most expensive kind of leather and gives the widest strips and the longest lengths of uniform density obtainable. The face of the wood is first sized as a bedding for the glue. The strap is placed in position as shown in Fig. 2, and stretched as it is wound around the wood center, both the leather and the wheel having been previously coated with hot glue. The ends of the straps are allowed to overlap and the butt joint made a close fit by cutting through both layers at the same time with a very thin sharp knife. The ends of the leather at the joint are held in place by wooden shoe pegs; in special cases iron pegs are used, which are removed after the glue is thoroughly set. In addition to holding the leather strap on the wood block with glue, wooden shoe pegs spaced in rows across the face of the wheel are used. Some straps are put on without pegs for the finer finishing processes. After the leather strap is thoroughly set, the wheel is placed in a lathe and the face turned off, leaving the greatest depth of leather possible. The strap is then sanded and finished, the wood part of the wheel well shellacked and varnished, and the wheel is ready for use when dry.

On large diameter thin wheels, 18 to 24 inches in diameter by 1 inch to 1½ inches face, side flanges of wood are used, these being glued to the body of the wheel to increase the thickness of the wheel at the hub and the resistance to side-warping. Sometimes an additional flange is used on the other end of the hub, but this is seldom necessary, and its use is a matter of custom rather than need.

Walrus Hide Wheels

Walrus hide is, as the name indicates, the hide of the walrus. Its soft, coarse, porous character permits it to be worked into a very soft cushion on the face of the polishing wheel. The hide comes in thicknesses of from ½ inch to 2 inches (occasionally 2½ inches), which permits a wheel to be cut out of one piece without gluing together disks, as is necessary in other forms of wheels. The great expense of walrus wheels has led the user of polishing wheels to seek other forms; the most common substitute for wheels 10 inches in diameter and larger, has been the compress canvas wheel, the control of the density of which permits a cushion to be secured that will do exactly the same class of work as the solid walrus wheel, with rare exceptions; but walrus wheels are still employed in the silverware trade, for "sand buffing," where polishing wheels of from 2 to 10 inches in diameter are most commonly used. There are many classes of work on which it would not be permissible to use any kind of wheel with glue or other adhesives in it, and the walrus wheel being of the proper texture, and thick enough to produce wheels up to 2 inches width of face, lends itself to that class of work. The manufacture of walrus wheels consists only in cutting out the circles, cutting the center hole, and truing up the sides and face.

Sheepskin polishing wheels have almost entirely disappeared, due to the substitution of other forms of wheels. They are, however, made up of russet or white sheepskin in the same manner as Dryer canvas disk wheels—that is either by gluing the full disks together at the center, or sewing them with one row around the center, or with several rows of hand sewing; or by cementing them together into a solid wheel. They are, of course, centered and trimmed in a lathe like all other wheels.

Paper wheels have almost gone out of existence, but they were formerly manufactured by gluing together disks of strawboard or soft felt paper, such as a carpet paper, cutting the center hole and truing up the face. In some cases cast-iron hubs were inserted as a special feature.

In the description of a line of manufacture of this kind, it is possible to include only the more standard forms of wheels made, as there are many varieties of wheels of special shapes for various purposes. The next article in this series will deal with the actual manufacture of compress polishing wheels.

* * *

IMPROVING INSPECTION METHODS

By H. H. ARMSTRONG

Inspection plays a particularly important part in plants where large quantities of cast-iron parts are machined on automatics. An automatic machine may operate continuously all day, with very little attention without spoiling a single piece of work; then again it may require constant attention and frequent adjustment in order to keep the work up to specifications. In any case, the finished work must be inspected with gages or micrometers, and all parts rejected that fail to meet requirements.

Inspecting the Work as it Comes from the Machine

If the work is inspected as soon as it comes from the machine, the inspector will detect any errors at once and have the set-up corrected before many pieces are spoiled. If he cannot do this and the operator does not check the pieces at all and is running, say, four machines, the pieces awaiting inspection quickly pile up in large quantities. This is obviously not a good practice, and too often results in the necessity for scrapping a large number of pieces. In such cases the inspector must sort out the spoiled pieces that cannot be used. While this prevents defective parts from reaching the assembly department, it does not prevent parts from being spoiled. A method that will bring the loss in scrapped parts down to a minimum is obviously desirable. The writer believes that in the majority of cases the desired results will be obtained by having the inspector act as a "machine checker." In other words, the inspector goes from one machine to another, continually testing the product as it comes from each machine. If he finds the work within limits, it is passed on to the next operation or to the assembly department, as the case may be. If the checker finds a machine that is producing work that is not up to requirements, it is a small matter to stop the machine and have the set-up corrected. He must then check the pieces that have been made and work back to the point where the spoiled parts first appeared. The spoiled pieces may then be segregated and thrown out.

When the operator sets up his machine for a job, it is good practice to have the inspector or checker carefully check the first piece produced. If the piece checks up with the drawing specifications, the machine may be put in operation and afterward checked periodically. Foremen in their efforts to meet the factory schedule do not like to have their work held up; consequently the machine checker is sometimes criticized or blamed by the foreman for holding up work that in his opinion will pass inspection. The inspector, however, should be amply backed up by the management for stopping work that he believes should not pass inspection. If the operator of an automatic has been started correctly on a piece of work and provided with gages so that he can inspect the work himself, there should be no excuse for spoiled parts. If a lot of work is done wrong, the checker may in some cases insist that the pieces be fixed up or salvaged by the operator on his own time. This will be a lesson for the operator that should make him more careful.

Inspection Procedure in Press Room Work

This procedure is equally applicable to press room work. Generally a man known as the die-setter sets up all work in the press room, and when he has produced a piece which in his estimation is right he passes it on to the checker. The checker carefully inspects the piece, and if it is found correct he instructs the operator to go ahead. If the operator is careful he will keep close watch of the work and if he notices any change in the product he will immediately take the piece to the checker for advice. There are so many things that may happen to a die while it is in operation that it is imperative for the inspector to keep constantly in touch with each machine.

What is true of the automatic machine department and the press room is equally true of nearly all departments. A careful study of the inspection methods and a checking up of the amount of work spoiled in various machining operations will serve to emphasize the importance of "machine checking" (checking the product as it comes from the machine) and show more clearly the impracticability of depending on a final inspection to eliminate defective parts.

* * *

EXPORTS OF MACHINE TOOLS AND METAL-WORKING MACHINERY TO DUTCH EAST INDIES, 1912-1921

Year*	Lathes	Sharpening and Grinding Machines	Other Machine Tools	Total of Machine Tools	All Other Metal-working Machinery	Total of Machine Tools and Metal working Machinery
1912	....	....	....	....	....	$26,443
1913	....	....	....	....	....	6,866
1914	....	....	....	....	....	20,216
1915	....	....	....	....	....	9,229
1916	....	....	....	....	....	56,281
1917	....	....	....	....	....	245 594
1918	$53,664	$8,737	$38,239	$100,640	$68,044	168,684
1919	273,302	27,412	81,144	381,858	232,640	614,498
1920	88,826	25,577	80,186	194,589	131,497	326,086
1921	76,512	17,165	104,660	198,337	163,059	361,396

Machinery

*Amounts given are for fiscal years, up to and including 1918, and for calendar years thereafter. The Department of Commerce statistics did not give machine tools separately previous to 1918.

The Manufacture of Compress Polishing Wheels—Third Article of a Series

By BRADFORD H. DIVINE, President, Divine Bros. Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE compress polishing wheel, as mentioned in one of the preceding articles in this series (see November MACHINERY), is a type of wheel in which the material, usually leather or canvas, is placed crosswise of the face of the wheel instead of the wheel being made up of parallel flat disks. The wheel consists of an angular ring, made up of rectangular pieces of material arranged radially and compressed to form a ring or "cushion" of polishing material one or more inches in depth. This cushion is assembled with side plates engaging annular recesses in the compressed ring. The side plates, in turn, are riveted to a hub. The manufacture of compress polishing wheels involves a number of methods that are quite different from those used in making polishing wheels of the solid type. The article in December MACHINERY referred to the solid disk type; the present article will deal specifically with the manufacture of compress polishing wheels.

The material from which the compress polishing wheel is made, even though it may be of the same general quality as that used for a disk wheel, has a decidedly different effect in polishing than the same material in a wheel of disk form. Practically all the materials used in solid disk wheels, such as leather, canvas, walrus hide, sheepskin, felt, and paper, may be used in the construction of compress wheels, but leather and canvas are by far the most commonly used. The object of the use of the different materials is to secure different degrees of density or "cushion" in the face of the wheel. Walrus hide, for example, is more porous and softer than leather, but a compress canvas wheel can be made which has practically the same density on the face as a disk walrus wheel, and which will do the same work equally well or better. Prejudice among old-time polishers is practically the only reason why other materials than leather or canvas are used in the manufacture of the compress style of wheel. The manufacturing process is essentially the same, no matter what the material used.

The leather used in the manufacture of compress polishing wheels is of various kinds. The softer wheels are made from thick, very porous bullneck leather, while the harder wheels are made from thin leather from which both the grain and the flesh side have been removed, and which has the greatest density. It is important that the density of the leather be uniform throughout the entire face of the wheel, and a great deal depends upon the intelligence and experience of the sorter of the leather in selecting that quality which is best adapted for the work to be performed. In addition to the quality of the material, the amount of compression to which the wheel is subjected during its manufacture governs to a large extent the density or "cushion" of the finished wheel.

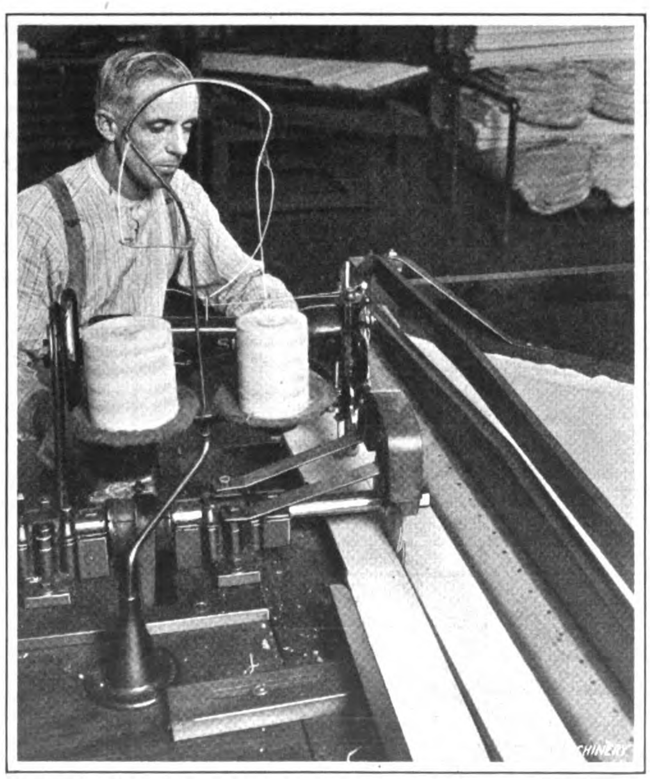


Fig. 1. Sewing the Edges of Strips of Canvas together for Compress Polishing Wheels

The Manufacture of Canvas Compress Wheels

In making canvas compress wheels, the canvas is arranged in layers of suitable thickness for handling during the manufacturing process and cut diagonally into strips, on the bias, so to speak. This step brings the yarns in the canvas at a 45-degree angle to the face of the wheel and avoids any possibility of raveling, which would occur if the weave lay square in relation to the face of the wheel. This position of the material also contributes to the cushion of the wheel.

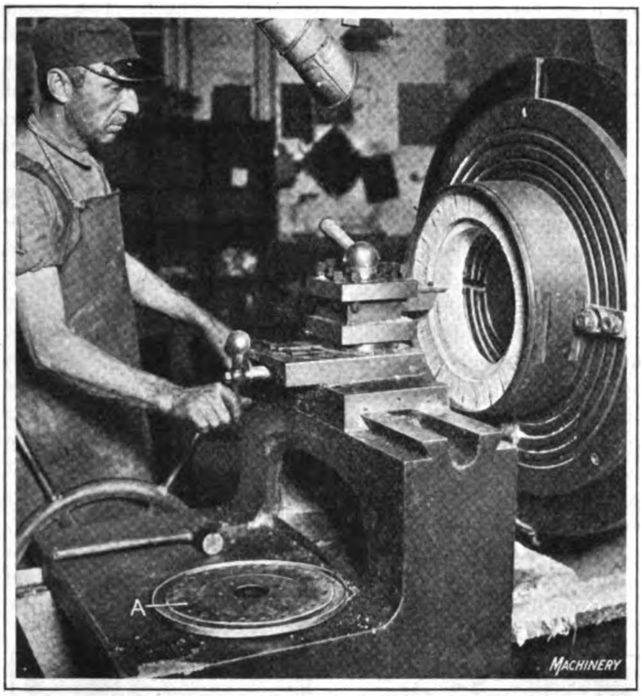


Fig. 2. Machining the Groove to receive the Edge of the Side Plates

Fig. 3. Assembling the Side Plates and the Cast-iron Hub

The strips of canvas are sewed on the edge to retain the plies in position during the manufacturing process as shown in Fig. 1, and then the strips are cut into blocks of the proper length and width. The blocks are assembled into a circle considerably larger than the finished diameter of the wheel is to be, and after being reduced by compression to the proper diameter, plates with channels on the outer edge are introduced into grooves turned in the sides of the circular canvas cushion near the inner edge. A hub is inserted between the plates, and then the whole mass is forced together in a hydraulic or heavy power press. The plates are next riveted together, balancing tubes are inserted, and the wheel removed from its compression holding apparatus. It is now ready for tooling to shape in a lathe.

Advantages of Compress Wheels

As compared with the disk form of wheel, it will be seen that no adhesive is necessary to hold the material together in the cushion of the wheel; also, there is no possibility of variation in the density of the face of the wheel throughout its working area, due to hard and soft spots in the leather, which will always be present in disk wheels; and inasmuch as the center of the wheel is metal, it is practically impossible for the wheel to change its shape because of atmospheric or other conditions. Furthermore, this form of assembly insures a wheel which will remain round, if properly used by the operator; and it is not reduced in diameter, as are all the disk wheels, because it does not have to be faced off constantly to keep it round and true.

Another advantage of placing the material crosswise of the wheel as described, is that a wheel of this kind can be turned to shape. Much polishing work is done nowadays on formed wheels following the principle of the formed milling cutter. The polishing wheel is turned to the exact shape of the article to be polished. It is not mechanically possible to turn wheels to shape when made of disks; furthermore, they do not retain their shape, as the spread of the disks throws the face out of shape sooner or later. The advantages of the formed wheel are obvious. A formed wheel covers the entire contour, or a portion of the contour, at one time, whereas a flat-faced wheel must work all over the surface to be polished, consuming more time with less accuracy in the finished piece. Often, instead of having several wheels for each particular form, a number of contours are cut into the face of one wheel, so that the operator can finish the job without having to set up another wheel.

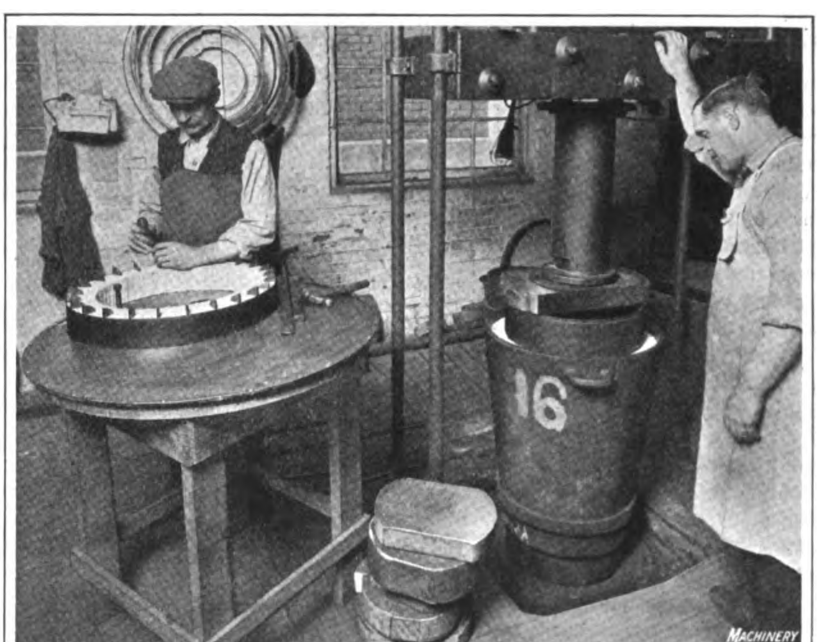


Fig. 4. Assembling the Blocks of Canvas into a Ring preparatory to compressing them with the Equipment shown at the Right

In converting the canvas for polishing wheels from sheet form into strip form, special sewing machines are used, as shown in Fig. 1, the machines having two needles; centrally located between the needles, but behind them there is a slitting saw. The "book" of canvas is placed on an angular traveling top with the edge of the canvas brought to a stop and clamped in place The stop has a straight edge and is adjustable to give any desired width of strip. The moving top travels backward and forward past the

needles, the edges of the canvas being sewed and the canvas cut into strips at the same time. This insures the strips of canvas having an absolutely straight and square edge like a block of metal, which is necessary for the proper assembly in the wheel of the blocks cut from the strips.

After the strips have been cut into blocks, these blocks are assembled to form a ring by placing them inside a steel band. In the operation of assembling the canvas in the steel bands, shown in Fig. 4, it will be seen that the operator is placing metal spacers between the blocks of canvas in order to give sufficient stability to permit the material to be compressed without collapsing. After compression, the spacers are removed to leave the wheel with the proper density on the face. Many of the wheels are required to be so soft on the face, when finished, that the finger can be inserted between the layers of canvas, while on the other hand other wheels are practically as hard as metal. The number of spacers depends, of course, upon the degree of density required.

The Compressing Process

In the compressing process, the assembling ring containing the canvas, leather, or other material is placed in the top

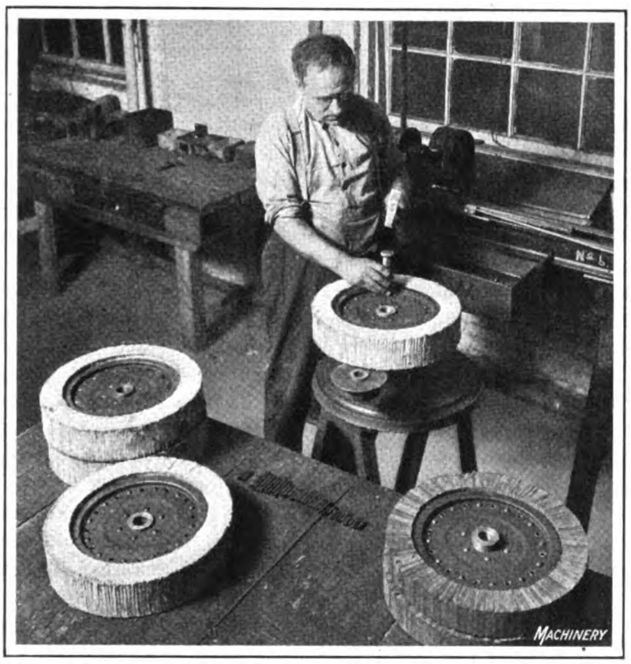


Fig. 5. Assembling the Balancing Tubes in the Compress Wheels

Fig. 6. Forming a Concave Face on a Leather Compress Wheel

of a large metal cylinder which is tapered. The annular ring of material is forced down through the cylinder by a hydraulic press or a power press. The pressure required varies according to the diameter of the wheel and the width of the face, but ranges from ten tons for the smaller wheels up to about sixty tons for the larger wheels. In the illustration, a ring of material is shown after it has been forced from the band and has started to be compressed in the tapered cylinder. After it has passed through the tapered cylinder, it is held in position in a cast-iron ring which is tooled to fit the lathe in which the ring of canvas or other material is finished on the inside and on both the side faces; at the same time a channel or groove is turned in each side, as shown in Fig. 2, to receive the edge of the side plates.

The operation of assembling the plates and the cast-iron hub riveted between the two plates is shown in Fig. 3, where the operator has already located one flange, placed the hub through the hole of the flange, and is about to put on the other side plate of the wheel. The whole assembly is held together by rivets which are headed with a power riveting machine. Extreme care must be taken not to bend the rivets between the plates, for the strain due to the speed of the polishing wheel would have a tendency to straighten the bent rivets, so that they would become loose, and thus loosen up the whole construction of the wheel. The wheel remains in the cast-iron holding ring or container until it is completely assembled, and there is nothing left to do but machine the face which, of course, is done after the wheel is removed from the holding ring.

Balancing the Wheels

For balancing the wheels, tubes are inserted through the plates, just underneath the inside edge of the polishing material, and a sufficient quantity of one-quarter inch lead wire is placed in them to accurately balance the wheels. If the piece of lead wire needed is shorter than the balancing tube it is upset in the tube, but if it is longer than the tube the ends are turned over and hammered down. In either case, the lead may readily be removed, without damaging the tubes, for use in any subsequent balancing operation. This process is illustrated in Fig. 5. The final work is the truing up of the wheels; this is done by mounting them on their own centers in a lathe, so that they will be mechanically round when finished.

Leather wheels are made in practically the same way as canvas wheels. Leather of uniform density is selected from the same location in a number of hides. Usually a large number of hides are required to produce a sufficient amount of similar material to manufacture an order of wheels. The leather is cut into strips like the canvas, and the strips are cut into rectangles. The leather pieces are often passed through rolls to taper them, and sometimes they are skived to give them a wedge shape and to assist in the radial assembly in the wheel.

Recommended Service for Various Compress Wheels

For work ordinarily done on disk bullneck wheels, a compress leather wheel made of medium density is well suited. Such a wheel with a two-inch depth of leather cushion has more spring than one in which the leather is one inch deep. Medium or soft density leather wheels are commonly used for flexible grinding, such as roughing operations on castings, forgings, stamped and drawn metals, etc. Such wheels with narrow faces have greater stiffness than disk wheels and reach better into the necks of valves, grooves of twist drills, and similar places, where the wheels must stand up to the work and be solid enough to hold their shape. For use on disk grinders, compress wheels of leather and canvas are often made in cup form, where the cushion overhangs the face on one side. A band of steel is placed around the circumference of the wheel to hold the

material against the strain of centrifugal force, and the abrasive material is applied on the side face of the wheel. This class of wheel is used to replace cloth and paper disks, for it is much cheaper to reset the wheels with the abrasive and glue than to purchase large disks when only a small area of the disk can be efficiently used.

The compress wheel with leather one inch deep in the polishing cushion is, of course, harder in density than that with the two-inch depth of cushion, and is used for classes of work where a more flexible wheel would not be satisfactory. Such a wheel, hard in density, will maintain the straight edge and surface on fine work, especially such work as sewing machine parts, or other parts having countersunk screw holes which must not be elongated. Typical examples of this class of work are firearm parts, such as pistol handles or rifle frames. This type of wheel is also used largely in the cutlery trade on automatic machines for finishing pocket knife blades where the fineness of the blade requires the most extreme accuracy in the wheel. It is also used for grinding the edges of the blades.

A certain class of polishers insist upon working on the flat side of the leather, as on leather-covered wood wheels; the compress leather wheel lends itself to securing a leather strap to the face of the wheel, which gives the advantages of the strap as well as the accuracy of the compress construction. This is a form of wheel largely used in England.

The compress construction covers a great variety of forms, of cushion densities and depths of cushion, and in the various constructions covers practically every possible range of polishing work, with rare exceptions. It is suitable both for dry polishing and for oil or grease wheels, and has advantages over any other form of wheel for holding sharp corners.

Special Compress Wheels

One rather special form of this wheel is the rubber and duck composition construction, which is manufactured only with the cushion one inch deep and is peculiarly suited for holding very coarse abrasives, such as No. 16 to 24. The abrasive and glue adheres to this composition material with great strength, beyond that of any other polishing wheel. It is peculiarly adapted for grinding castings and forgings, but is not in any sense a finishing wheel. Another very hard wheel is manufactured in the compress construction by using paper or strawboard. Such wheels are often covered with a leather strap, wherever an extremely hard wheel is desired. A good many polishers still insist upon having compress wheels made of felt and walrus hide for some of the finest finishing work.

* * *

THE MACHINE TOOL MARKET IN NEW ZEALAND

By DAVID K. BLAIR, Director, Blair, Reed & Co., Ltd., Wellington, New Zealand

New Zealand is not an industrial country, and as there are very few metal-working shops, the market for machine tools is limited. This must necessarily be so when the population is only about 1,250,000. The Government controls the railroads, and has four large and several small shops in different parts of the country for maintaining the rolling stock. The large shops employ about 1000 men and are fairly well equipped, although a considerable portion of the machinery is quite out of date and should be replaced. Prior to the war, the reorganization of the railroads generally was contemplated. Nothing has yet been done in connection with the shops; but large orders have been placed in England for locomotives and other rolling stock.

There are several well equipped private shops employing from 50 to 200 men. One of these specializes in the manufacture of locomotives, while others make oil engines, pumps, dairy equipment, flax strippers, and agricultural machinery. Some of the small shops confine themselves to the cutting of automobile replacement gears and the manufacture of oil-engine pistons. None of these shops, so far as the writer knows, are equipped with automatic gear-cutting machines, the gear teeth being generally cut by milling, as there is not a sufficient demand for any one size of gear to justify the installation of automatic machines. One of the shops manufactures a post-office machine which is supplied to all parts of the world. This shop also specializes in the maintenance and repair of motion-picture machines and turns out parts equal to any imported.

Machine Tools Mainly of American Manufacture

The total annual demand for machine tools would be somewhat difficult to ascertain, but it is not very great. The chief demand is for lathes up to 12 inches swing, with 6-foot beds, for use in automobile and motorcycle repair shops. Drilling machines are next in importance, and then come tool-grinders and milling machines. Most of the machine tools are of American manufacture, and, if not, follow closely American design, especially in the case of upright drilling machines, tool-grinders, shapers, and milling machines. Shapers, however, are not numerous, and are chiefly found in the repair shops. Quite a number of lathes are provided with electric grinding equipment for finishing cylinders, shafts, etc. There is only a limited number of universal grinding machines—probably not more than thirty in the whole country. There are about a dozen technical schools in New Zealand, and all of these have fairly good shops for the training of students. The bulk of the equipment in these shops is also of American make.

Cutters and Mechanics' Tools

Twist drills, reamers, lathe tools, taps, dies, etc., as a rule, are of American manufacture. Occasionally, British tapping and threading equipment is seen, but in the writer's opinion, it is not as good as that coming from the United States. The bulk of mechanics' tools are also American made, with the exception of wood chisels, which are generally of Sheffield manufacture. Formerly, there were quite a number of German tools, such as bits, pliers, taps, die-stocks and blow-torches, but since the war a tool of German manufacture is rarely seen. Blow-torches now generally come from Sweden.

Wood-saws, carpenters' hammers, and axes are almost universally American-made, and practically all fine measuring instruments, such as micrometers, come from the United States. New Zealand has quite a number of fine large fruit-canning establishments, and in these, the equipment is also almost entirely American. Only rarely is a British or Australian machine seen.

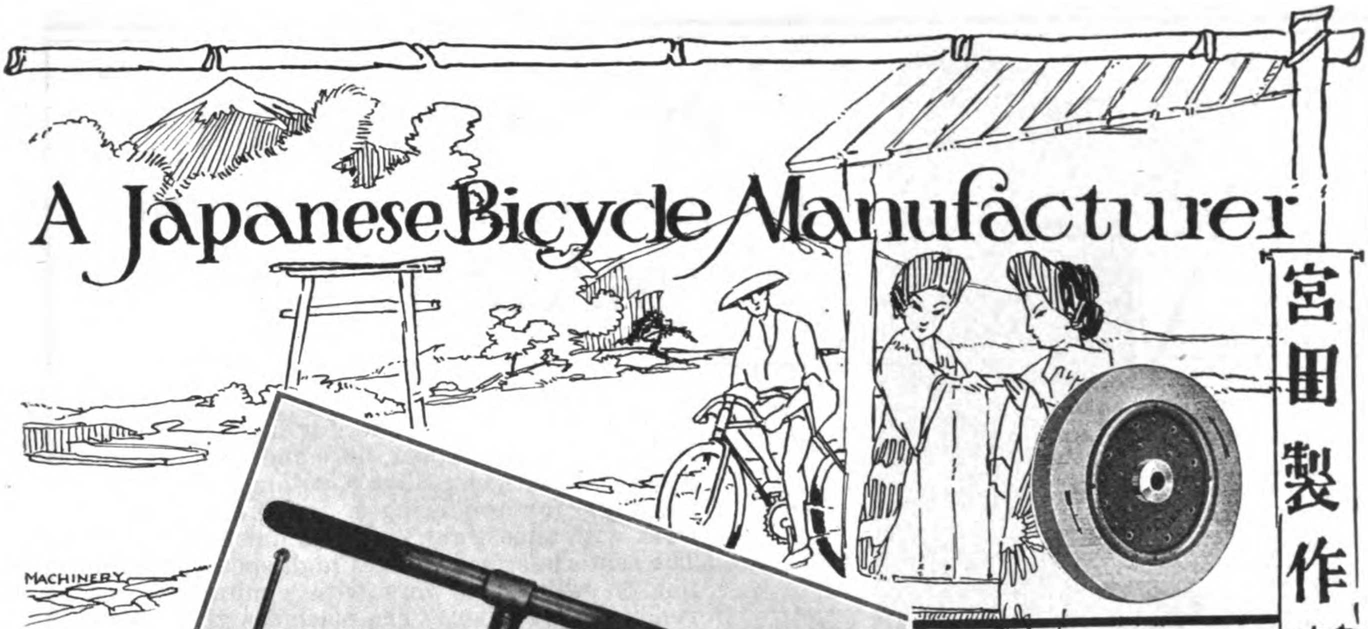
Duty on Imported Machinery

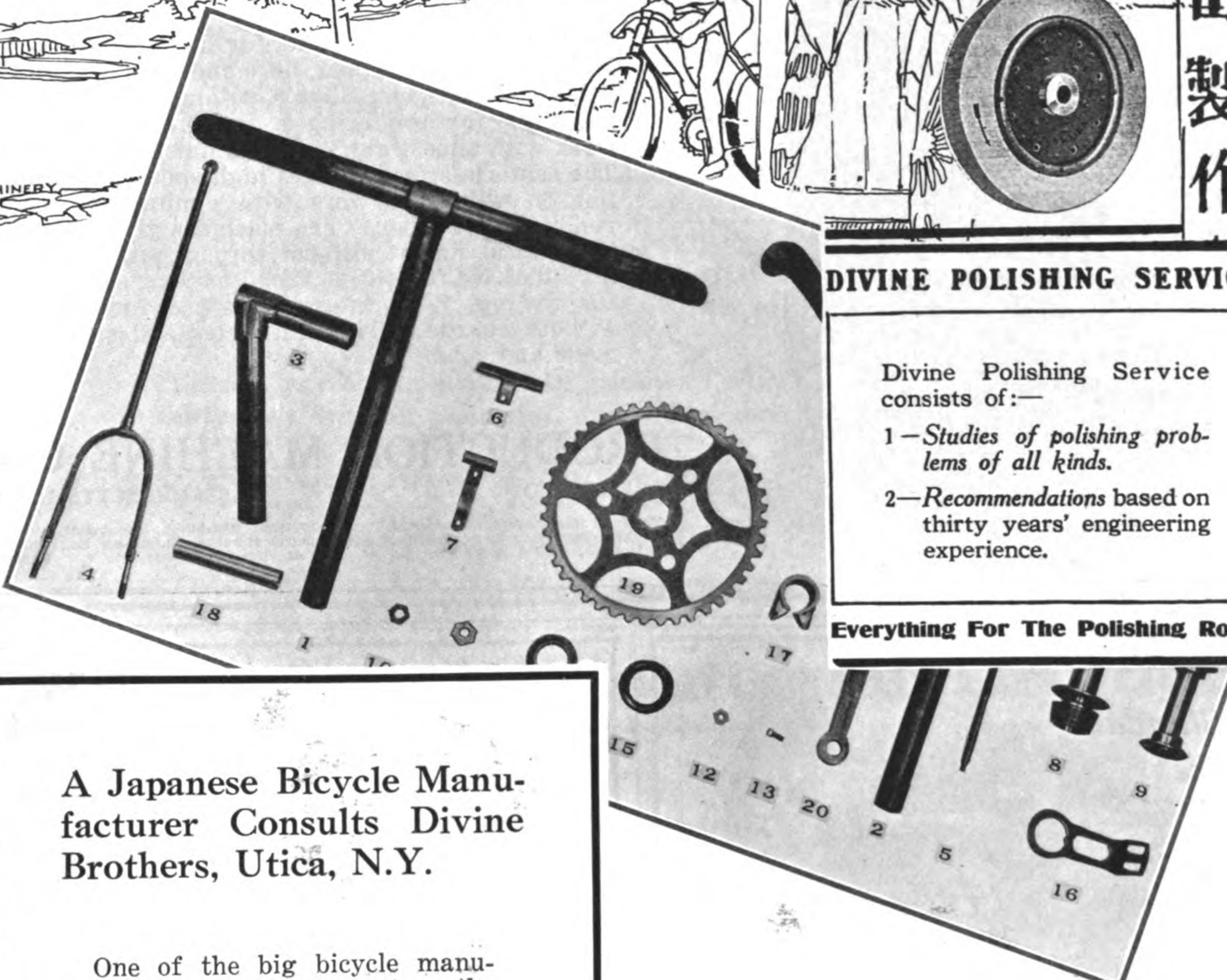
For the last few years about 60 per cent of all machines and tools imported into New Zealand have come from the United States, the remaining 40 per cent being divided among British and foreign manufacturers. New tariff laws which went into effect last June considerably changed the duty on imports. Under the old tariff, machinery and mechanics' tools were admitted free, irrespective of the country from which they were imported, but now only British products are admitted free. Foreign products are taxed to the extent of approximately 10 per cent of their value. An additional 1 per cent primage tax is applied both on free and dutiable goods.

The conclusions here given are the result of observations extending over the twenty-three year period during which the concern with which the writer is connected—a distinctly New Zealand organization—has been selling machine tools in New Zealand.

* * *

The Dutch East Indies in 1921 absorbed more than four times as much machinery as in 1911. During that period the share of this business secured by America has expanded from 264,000 to 5,701,000 guilders (1 guilder = $0.402).





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